L Number	Hits		DB	Time stamp
5	24	(sulphite same cooking) same xylose	USPAT;	2003/10/08 17:47
			US-PGPUB;	
			EPO; JPO;	
	1		DERWENT;	
			IBM_TDB	
6	12	((sulphite same cooking) same xylose) and	USPAT;	2003/10/08 17:53
		arabinose	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
7	520	magnesium adj sulphite	IBM_TDB USPAT;	2003/10/08 17:53
,	320	magnesium adj suiphite	US-PGPUB;	2003/10/08 17.33
			EPO; JPO;	
			DERWENT;	
	ŀ		IBM TDB	
8	48	mg adj sulphite	USPAT;	2003/10/08 17:53
			US-PGPUB;	, _ , , , , , , , , , , , , , , , , , ,
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
9	558	(magnesium adj sulphite) (mg adj sulphite)	USPAT;	2003/10/08 17:53
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
10	4	((magnesium adj sulphite) (mg adj sulphite))	USPAT;	2003/10/08 18:01
		and xylose and liquor and arabinose and	US-PGPUB;	
ĺ		rhamnose	EPO; JPO;	
			DERWENT;	
11	0	4075406 nn and magnegium	IBM_TDB	2002/10/00 18 02
_ <u> </u>	١	4075406.pn. and magnesium	USPAT;	2003/10/08 18:02
			US-PGPUB; EPO; JPO;	
			DERWENT;	
			IBM TDB	
12	0	4075406.pn. and mg	USPAT;	2003/10/08 18:02
			US-PGPUB;	2000, 20, 00 20102
			EPO; JPO;	
·			DERWENT;	
			IBM_TDB	
13	2	4075406.pn.	USPAT;	2003/10/08 18:02
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
14	0	4075406.pn. and sulphite	USPAT;	2003/10/08 18:02
			US-PGPUB;	
			EPO; JPO;	
			DERWENT; IBM_TDB	
_	2	5998637.pn.	USPAT;	2003/03/26 11:23
		3550037.pm.	US-PGPUB;	2003/03/20 11:23
			EPO; JPO;	
			DERWENT;	
			IBM TDB	
_	2	5998607.pn.	USPAT;	2003/03/24 14:25
	_	*	US-PGPUB;	, , == ================================
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	1404	rhamnose and (cation near "3" exchange)	USPAT;	2003/03/25 11:54
			US-PGPUB;	
•			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	400	(rhamnose and (cation near "3" exchange))	USPAT;	2003/03/25 11:54
ļ		and weak	US-PGPUB;	
İ			EPO; JPO;	
	İ		DERWENT;	
			IBM TDB	1

<b>-</b>	4	((rhamnose and (cation near "3" exchange))	USPAT;	2003/03/25 12:03
	1	and weak) and finex	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
l _	484	(weak weakly) adj cation	IBM_TDB USPAT;	2003/03/25 12:04
-	404	( weak weakiy) adj cacion	US-PGPUB;	2003/03/25 12:04
}			EPO; JPO;	
			DERWENT;	
			IBM_TDB	0000/00/05 10 04
-	0	((weak weakly) adj cation) same rhamnose	USPAT; US-PGPUB;	2003/03/25 12:04
			EPO; JPO;	
	1		DERWENT;	
			IBM_TDB	
-	10	((weak weakly) adj cation) and rhamnose	USPAT;	2003/03/25 12:08
			US-PGPUB; EPO; JPO;	
			DERWENT;	
	1		IBM_TDB	-
-	111	((weak weakly) adj cation) and sugar	USPAT;	2003/03/25 15:49
			US-PGPUB;	
1			EPO; JPO; DERWENT;	
			IBM TDB	
-	131	sequential same continuous same bed	USPAT;	2003/03/25 15:49
			US-PGPUB;	
			EPO; JPO;	
			DERWENT; IBM TDB	
-	30	(sequential same continuous same bed) same	USPAT;	2003/03/25 15:49
		moving	US-PGPUB;	
		_	EPO; JPO;	
			DERWENT;	
_	2	   "20010009136"	IBM_TDB USPAT;	2003/03/26 11:24
_	2	20010009130	US-PGPUB;	2003/03/20 11:24
		, and the second	EPO; JPO;	
			DERWENT;	
			IBM_TDB	2002/02/26 11:05
-	2	"20010009236"	USPAT; US-PGPUB;	2003/03/26 11:25
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
_	0	"20010009236" and (weak weakly)	USPAT;	2003/03/26 11:24
			US-PGPUB; EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	1	"20010009236" and (xylose rhamnose)	USPAT;	2003/03/26 11:26
			US-PGPUB;	
			EPO; JPO; DERWENT;	
			IBM TDB	
-	1	"20030006191"	USPAT;	2003/03/26 11:27
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
_	1	"20030006191" and (xylose rhamnose weak	IBM_TDB USPAT;	2003/03/26 12:50
		veakly) \	US-PGPUB;	-000,00,20 12.50
		• •	EPO; JPO;	
			DERWENT;	
	1.55	(managagharida sasaharida)	IBM_TDB	2002/02/25 12 55
_	1553	(monosaccharide saccharide) same chromatograph\$	USPAT; US-PGPUB;	2003/03/26 12:51
		CITOMACOGLAPIIO	EPO; JPO;	
			DERWENT;	
			IBM_TDB	

-	20	((monosaccharide saccharide) same	USPAT;	2003/03/26 12:59
		chromatograph\$) same (weak weakly)	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
1			IBM_TDB	
-	17306	hplc same ph	USPAT;	2003/03/26 12:59
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
1			IBM_TDB	
-	17306	hplc same ph	USPAT;	2003/03/26 13:00
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	81	(hplc same ph) same weak	USPAT;	2003/03/26 13:01
1			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	9	1 1 2 2	USPAT;	2003/03/26 14:47
		acid)	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	0	F =	USPAT;	2003/03/26 14:48
		arabinose)	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	0	(hplc same (rhamanose xylose arabinose))	USPAT;	2003/03/26 14:48
		same weak	US-PGPUB;	
1			EPO; JPO;	
			DERWENT;	
İ			IBM_TDB	( (
-	0	(hplc same (rhamanose xylose arabinose))	USPAT;	2003/03/26 14:48
		same weakly	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	0	(hplc same (rhamanose xylose arabinose))	USPAT;	2003/03/26 14:48
		same weak\$	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	0000 (00 (00 00 00
-	151	hplc same (rhamanose xylose arabinose)	USPAT;	2003/03/26 14:50
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
		(h-1 (	IBM_TDB	2002/02/26 14 50
-	44	1 •	USPAT;	2003/03/26 14:52
	1	weak\$	US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
	1	(hala anno (whomeness surlans surliness))	IBM_TDB	2002/02/26 35:05
-	29	(hplc same (rhamanose xylose arabinose)) and	USPAT;	2003/03/26 15:06
		(amberlite finex)	US-PGPUB;	
		1	EPO; JPO;	
			DERWENT;	
1	1065	(week near 6045502 DN agid) and halo and	IBM_TDB   USPAT;	2003/03/26 15:11
-	1002	(weak near 6045593.PN. acid) and hplc and rhamnose	US-PGPUB;	2003/03/20 13:11
	1		EPO; JPO;	
	1		1	
1			DERWENT; IBM TDB	
<u> </u>	364	((weak near 6045593.PN. acid) and hplc and	USPAT;	2003/03/26 15:07
-	364	rhamnose) and cation	US-PGPUB;	2003/03/20 15:07
1		Inamiose, and cacton	EPO; JPO;	į l
			DERWENT;	
			IBM TDB	
L	J		מעד ויום ד	<u>.                                    </u>

-	18	(((weak near 6045593.PN. acid) and hplc and rhamnose) and cation) and divinyl	USPAT; US-PGPUB;	2003/03/26 15:08
			EPO; JPO; DERWENT; IBM_TDB	
-	28	(weak near3 acid) and hplc and rhamnose	USPAT; US-PGPUB; EPO; JPO;	2003/03/26 15:38
_	2	5466294.pn.	DERWENT; IBM_TDB USPAT;	2003/03/26 15:50
		•	US-PGPUB; EPO; JPO; DERWENT;	
-	807	chromatography and cation and rhamnose	IBM_TDB USPAT; US-PGPUB;	2003/03/26 15:51
	200		EPO; JPO; DERWENT; IBM_TDB	2002/02/06 15 50
-	390	(chromatography and cation and rhamnose) and weak\$	USPAT; US-PGPUB; EPO; JPO; DERWENT;	2003/03/26 15:52
-	43	(chromatography and cation and rhamnose) and (weak adj acid)	IBM_TDB USPAT; US-PGPUB;	2003/03/26 16:41
			EPO; JPO; DERWENT; IBM_TDB	
-	22	hplc same (rhamnose and xylose)	USPAT; US-PGPUB; EPO; JPO; DERWENT;	2003/03/26 16:43
-	10	(hplc same (rhamnose and xylose)) and weak\$	IBM_TDB USPAT; US-PGPUB; EPO; JPO;	2003/03/26 16:43
-	842	127/46.2.ccls. 127/46.3.ccls. 127/46.1.ccls.	DERWENT; IBM_TDB USPAT; US-PGPUB;	2003/03/28 12:37
			EPO; JPO; DERWENT; IBM TDB	
-	14	(127/46.2.ccls. 127/46.3.ccls. 127/46.1.ccls.) and rhamnose	USPAT; US-PGPUB; EPO; JPO; DERWENT;	2003/03/28 12:37
-	3	((127/46.2.ccls. 127/46.3.ccls. 127/46.1.ccls.) and rhamnose) and (weak weakly)	IBM_TDB USPAT; US-PGPUB; EPO; JPO;	2003/03/28 12:39
-	1043151		DERWENT; IBM_TDB USPAT;	2003/03/28 12:40
			US-PGPUB; EPO; JPO; DERWENT;	
-	2	536/("124" "127" "128" 1.1).ccls.	IBM_TDB USPAT; US-PGPUB; EPO; JPO;	2003/03/28 12:40
-	1886	536/124.ccls. 536/127.ccls. 536/128.ccls. 536/1.1.ccls.	DERWENT; IBM_TDB USPAT; US-PGPUB;	2003/03/28 12:41
			EPO; JPO; DERWENT; IBM TDB	

-	117	(536/124.ccls. 536/127.ccls. 536/128.ccls. 536/1.1.ccls.) and rhamnose	USPAT; US-PGPUB; EPO; JPO;	2003/03/28 12:41
			DERWENT;	
1_	25	((536/124.ccls. 536/127.ccls. 536/128.ccls.	IBM_TDB USPAT;	2003/03/28 12:44
	25	536/1.1.ccls.) and rhamnose) and (weak	US-PGPUB;	2003/03/26 12.44
		weakly)	EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	1221	210/663.ccls. 210/660.ccls. 210/661.ccls.	USPAT;	2003/03/28 12:44
			US-PGPUB; EPO; JPO;	
			DERWENT;	
,			IBM TDB	
-	3	(210/663.ccls. 210/660.ccls. 210/661.ccls.)	USPAT;	2003/03/28 12:45
		and rhamnose	US-PGPUB;	
		'	EPO; JPO; DERWENT;	
			IBM TDB	
-	6	"1234404"	USPAT;	2003/05/05 14:21
			US-PGPUB;	
			EPO; JPO; DERWENT;	
			IBM TDB	
_	38	"0113547"	USPAT;	2003/05/05 14:21
			US-PGPUB;	
			EPO; JPO;	
			DERWENT; IBM TDB	
_	118319	ion adj exchange	USPAT;	2003/10/02 15:53
			US-PGPUB;	
			EPO; JPO;	
_	25448	   (ion adj exchange) same chromatography	DERWENT USPAT;	2003/10/02 15:53
	23440	(1011 adj exchange) same chromacography	US-PGPUB;	2003/10/02 13:33
			EPO; JPO;	
			DERWENT	0000/10/00 15 50
-	1	(ion adj exchange) same chromatopgraphy	USPAT; US-PGPUB;	2003/10/02 15:53
			EPO; JPO;	
			DERWENT	
-	3389	,	USPAT;	2003/10/02 15:54
		same (ion adj exchange adj resin)	US-PGPUB; EPO; JPO;	
			DERWENT	
-	12	(((ion adj exchange) same chromatography)	USPAT;	2003/10/02 16:08
		same (ion adj exchange adj resin)) same	US-PGPUB;	
		ribose	EPO; JPO; DERWENT	
-	2	5998607.pn.	USPAT;	2003/10/02 16:08
		_	US-PGPUB;	
			EPO; JPO;	
_	1	   5998607.pn. and (weak\$ slight\$)	DERWENT USPAT;	2003/10/02 16:20
-		3330007.pm. and (weaks singing)	US-PGPUB;	2003/10/02 10:20
			EPO; JPO;	
			DERWENT	
-	2	"20020120135"	USPAT;	2003/10/02 16:20
			US-PGPUB; EPO; JPO;	
			DERWENT	
-	0	"20020120135" and aminex	USPAT;	2003/10/02 16:21
			US-PGPUB; EPO; JPO;	
			DERWENT	
-	О	"20020120135" and hpx4	USPAT;	2003/10/02 16:21
			US-PGPUB;	
[			EPO; JPO;	
	L	<u> </u>	DERWENT	<u> </u>

				<del></del>
-	0	"20020120135" and hpx\$	USPAT; US-PGPUB;	2003/10/02 16:33
			EPO; JPO;	
			DERWENT	1
-	3914	(RHAMNOSE ARABINOSE XYLOSE) and (weak	USPAT;	2003/10/02 16:33
		weakly)	US-PGPUB;	
			EPO; JPO;	
		(DUAMNOCE ADADINOCE VVI COD) ()	DERWENT	2002/10/02 16 33
-	547		USPAT; US-PGPUB;	2003/10/02 16:33
		weakly)	EPO; JPO;	
			DERWENT	
-	23	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	USPAT;	2003/10/02 16:34
	]	weakly)) same (resin chromatography)	US-PGPUB;	
			EPO; JPO;	
_	15	(((RHAMNOSE ARABINOSE XYLOSE) same (weak	DERWENT USPAT;	2003/10/02 17:06
_	13	weakly)) same (resin chromatography)) and	US-PGPUB;	2003/10/02 17:06
		(acid acidic) and cation	EPO; JPO;	
		·	DERWENT	
-	0	xylose adj side adj stream	USPAT;	2003/10/02 17:06
			US-PGPUB;	
			EPO; JPO;	
_	1	xylose adj process adj stream	DERWENT USPAT;	2003/10/02 17:07
		Ayrobe adj process adj seream	US-PGPUB;	2003/10/02 17:07
			EPO; JPO;	
			DERWENT	
-	25	xylose and (side adj stream)	USPAT;	2003/10/02 17:07
			US-PGPUB;	
			EPO; JPO; DERWENT	
-	2	xylose same (side adj stream)	USPAT;	2003/10/02 17:07
	[		US-PGPUB;	-000, 20, 02 17.07
			EPO; JPO;	
			DERWENT	
-	48	mg adj sulfite	USPAT;	2003/10/08 11:48
			US-PGPUB; EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	48	mg adj sulphite	USPAT;	2003/10/08 11:48
	ļ		US-PGPUB;	
1			EPO; JPO;	
			DERWENT;	
_	48	mg adj sulfite) (mg adj sulphite	USPAT;	2003/10/08 11:48
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
	8	((mg adj sulfite) (mg adj sulphite)) same	IBM_TDB	2002/10/09 11:51
-		(mg ad) suffice) (mg ad) sufphite)) same	USPAT; US-PGPUB;	2003/10/08 11:51
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	792	sulphite same cooking	USPAT;	2003/10/08 11:51
			US-PGPUB;	
			EPO; JPO; DERWENT;	
			IBM TDB	[
_	24	(sulphite same cooking) same xylose	USPAT;	2003/10/08 17:47
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
_	0	5998607.pn. and acrylic	IBM_TDB USPAT;	2003/10/08 12:01
		Joseph and delytic	US-PGPUB;	2003/10/00 12:01
1			EPO; JPO;	
			DERWENT;	
1			IBM TDB	1

-	0	purolite same acrylic same "105"	USPAT;	2003/10/08 12:02
			US-PGPUB;	
			EPO; JPO;	
			DERWENT;	
			IBM_TDB	
-	14	purolite same acrylic	USPAT;	2003/10/08 12:02
			US-PGPUB;	
			EPO; JPO;	1
			DERWENT;	
			IBM TDB	

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<u>Life Science Research</u> > <u>Chromatography | Protein Purification</u> > <u>Chromatography Media</u> > **Ion Exchange** 

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UNOsphere Ion Exchange Resins

Macro-Prep Ion Exchange Media

AG, Bio-Rex, and Chelex Analytical Grade Resins

Molecular Biology and Biotechnology Grade Resins

Reactor Grade Resins

# Ion Exchange

Ion exchange chromatography separates molecules based on their net charges. Negatively or positively charged functional groups are covalently bound to a solid support matrix, yielding either a cation or anion exchanger, respectively. When a charged molecule is applied to an exchanger of opposite charge, it is adsorbed, while neutral ions or ions of the same charge are eluted in the void volume of the column. Binding of the charged molecules is reversible, and adsorbed molecules are commonly eluted with a salt or pH gradient. Ion exchange media are available in various particle sizes, ionic forms, and purity ranges.

#### **Resin Selection Parameters**

### Isoelectric Point

Selection of an ion exchange support depends on the properties of the molecules to be separated. For amphoteric molecules, the isoelectric point (pI) of the molecule and its stability at various pH values determine the separation strategy. At a pH above its pI, the molecule of interest will be negatively charged and at a pH below its pI, the molecule will be positively charged. Thus, if the molecule is stable at a pH above its pI, an anion exchange support is used. Conversely, if the molecule is stable at a pH below its pI, a cation exchange support is used. The operating pH also determines the type of exchanger to use. A strong ion exchange resin maintains capacity over a wide pH range, while a weak one loses capacity when the pH moves beyond the pK of its functional group.

Reso Type	Cation Exchanger	Anion Exchanger
Net Cierge Of Moderale Of Mineral	+	
©12109 of Reeto		+
Rening Candilens	Run at 0.5-1.5 pH units below the pl of the molecule of interest	Run at 0.5–1.5 pH units above the pt of the molecule of interest

Separation strategy for amphoteric molecules. If the molecule is stable at a pH above its pI, an anion exchange resin is used. If the molecule is stable at a pH below its pI, a cation exchange resin is used.

## Ionic Form

Many ion exchange media are available in several lonic forms and may be converted from one form to another. The ionic form of a support refers to the counterion presently adsorbed by the resin's functional group. Counterions will exhibit specific selectivities for each resin. The lower the selectivity of a counterion toward the resin, the more readily it is exchanged for another ion of like charge. Consequently, the appropriate ionic form will depend on the relative selectivity of the sample ion to be adsorbed. In general, the ionic form should have a lower selectivity for the functional group than the sample ion, so that the sample ion will displace the counterion and be adsorbed by the resin. The sample ion can then be eluted by a second counterion with a higher selectivity for the resin.

## Porosity

The porosity of a support refers to the total pore volume within the matrix of the support. The greater the pore volume, the higher the porosity. A very porous support may have either many small pores or a few large pores. The exclusion limit of a support is defined by the size of the largest molecule able to enter the pores under a given set of conditions. Porous media with high exclusion limits are recommended for high molecular weight molecules such as proteins, antibodies, and other biomolecules. Low- or high-porosity media with low exclusion limits are recommended for the separation of low molecular weight molecules such as inorganic ions and organic acids. High-porosity media include Macro-Prep, Blo-Gel, and Bio-Rex 70 media. Less porous media include AG and Chelex resins.

## Particle Size

Particle size is measured in micrometers, with dry mesh or wet mesh designations. The wet particle diameter will vary from resin to resin and depends on lonic form resulting from differences in the hydration of the particles. Smaller particle sizes provide higher resolution and typically require lower operational flow rates; larger particle sizes yield lower resolution but can be operated at higher flow rates.

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